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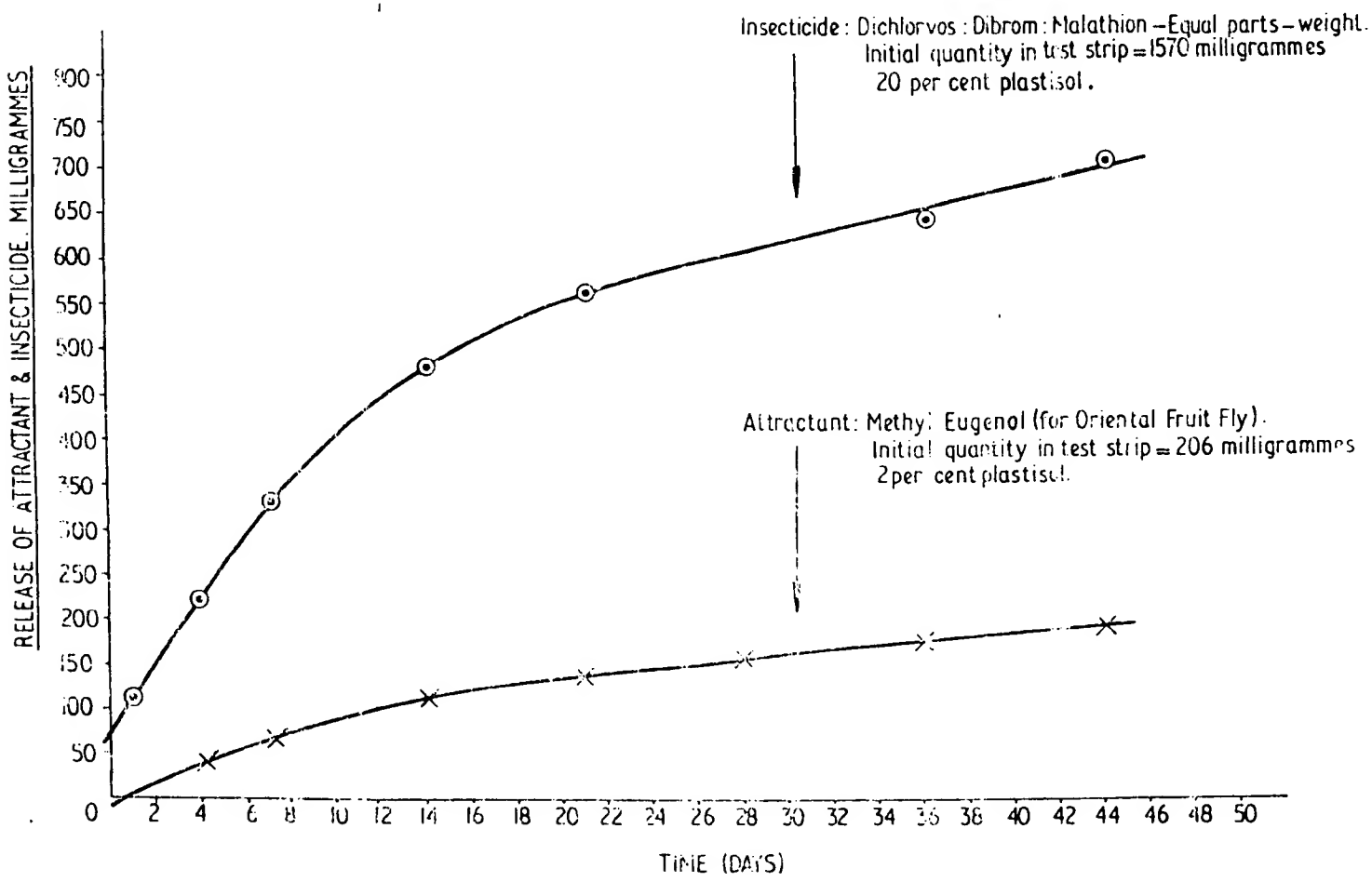
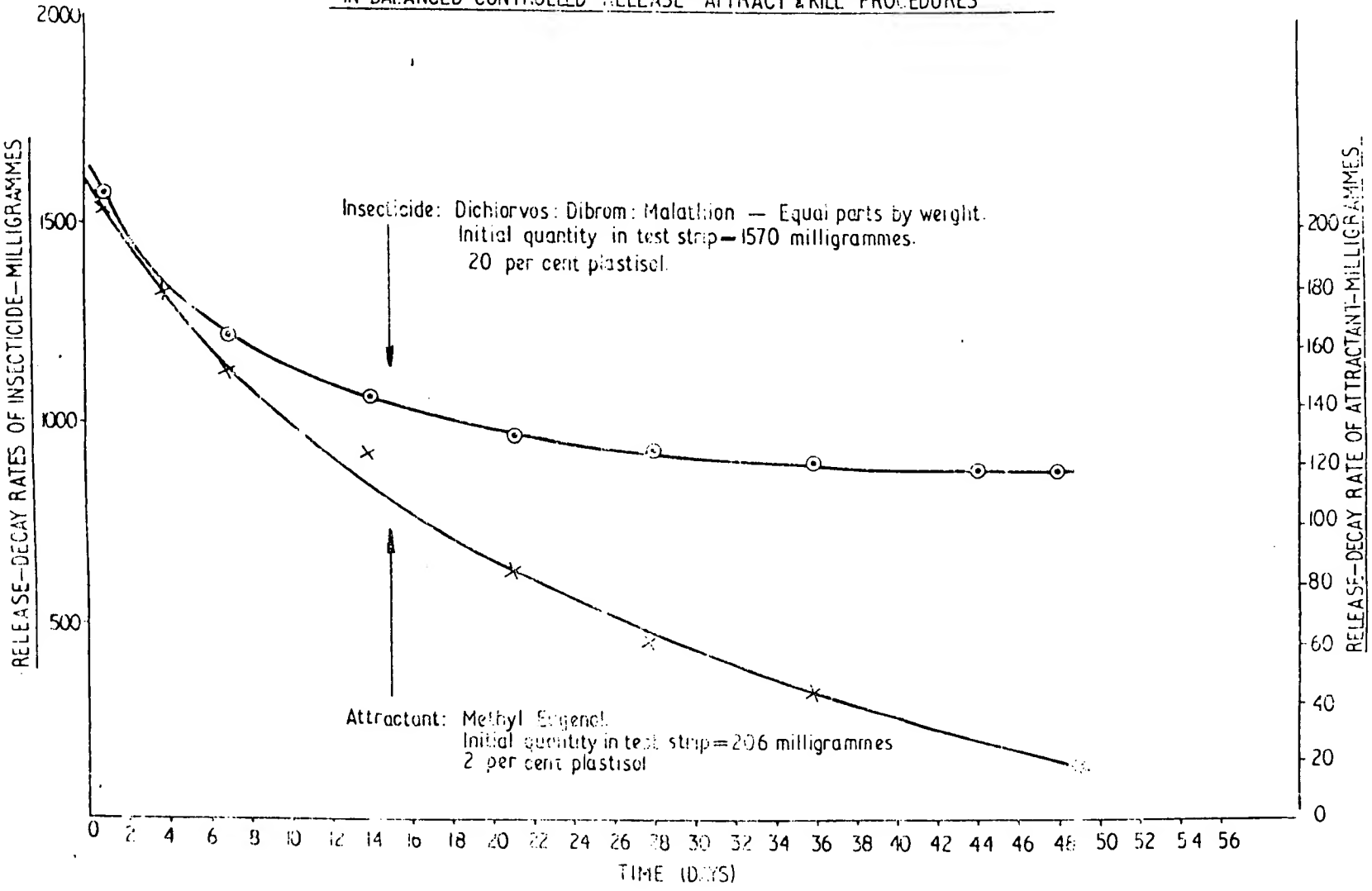
(54) Insect control systems

(57) This invention relates to insect control systems comprising insect attractants and insecticides in carrier compositions formulated to ensure comparable effective lives for the two compositions. The carriers may be P.V.C., P.V.A. or acetate chloride copolymers, polyolefins, chlorinated polyethylene, urea and melamine formaldehyde resins, polyesters, polyurethanes, polyureas, gelatins, straw, cane, lignocellulose, silica, aluminosilicates or clays, or the active substances may be microencapsulated. The compositions may be in the form of tapes or strings, or particles disposed on a polymeric sheet. The system may be used in conjunction with an insect trap.

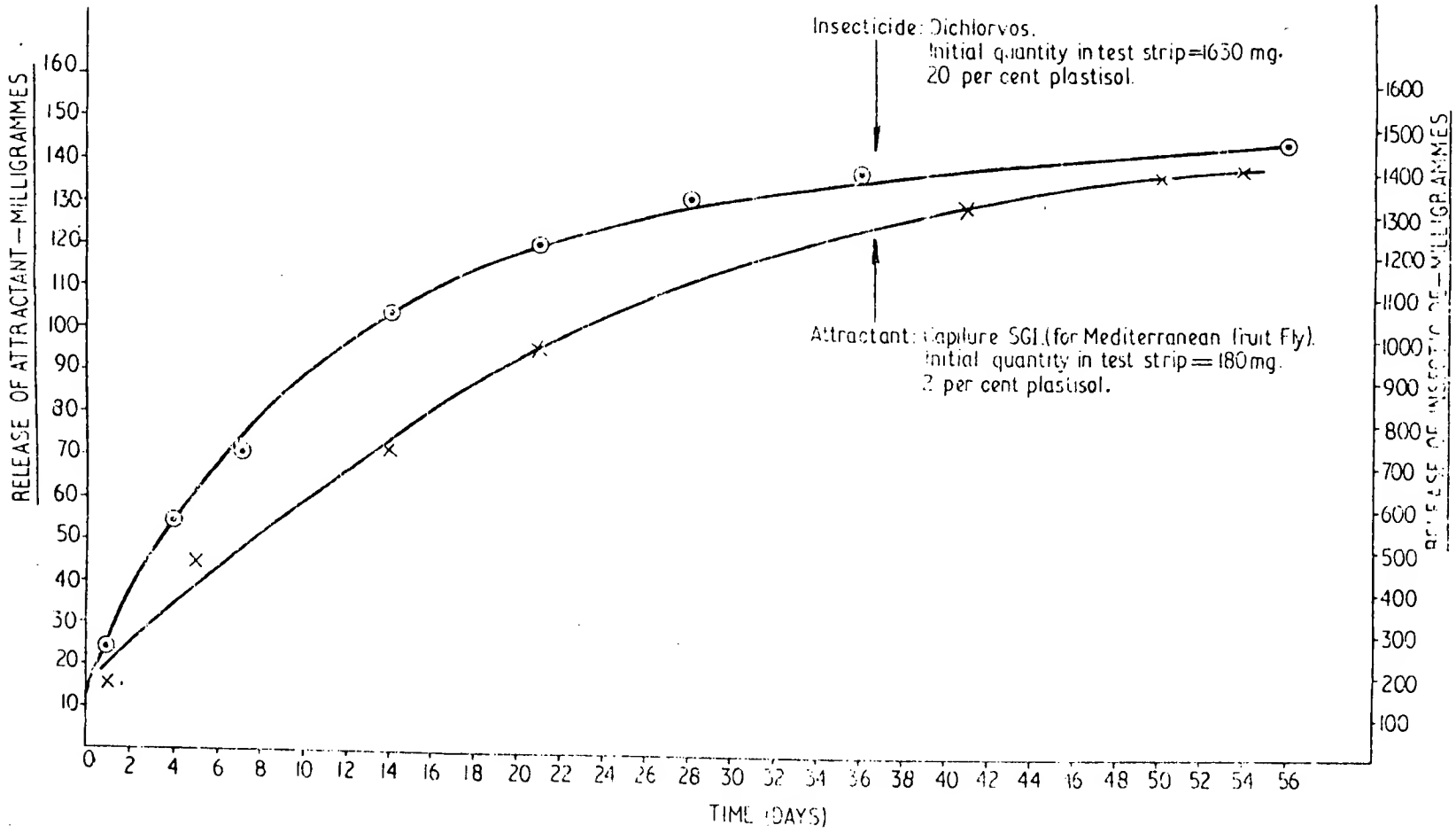
GRAPH I - EXAMPLE I. LIFE AND RELEASE OF ATTRACTANT AND INSECTICIDE IN BALANCED CONTROLLED RELEASE "ATTRACT & KILL" PROCEDURES



GRAPH IA – EXAMPLE IA RELEASE-DECAY RATES OF ATTRACTANT AND INSECTICIDE IN BALANCED CONTROLLED RELEASE 'ATTRACT & KILL' PROCEDURES



GRAPH 2 – EXAMPLE II. LIFE AND RELEASE OF ATTRACTANT AND INSECTICIDE IN BALANCED CONTROLLED RELEASE "ATTRACT & KILL" PROCEDURES



SPECIFICATION

Insect control systems

This invention relates to insect control systems. More particularly, the invention relates to an insect control system which optimises and generally minimises the use of insecticides and can, in preferred forms, be species specific with regard to the insects affected by the system.

The term "insecticide" as used in this specification is intended to include orthodox chemical insecticides and appropriate insect virus, bacterial or hormone compositions able to affect the specific insect species under attack. The insecticide can be of the contact type, or one which is effective in the form of its vapour.

Insecticides have been used for many years to combat various insect species which cause damage to crops. Insecticides are frequently dangerous and persistent chemicals and, hitherto, they have usually been applied to crops by dusting or spraying, either from the ground or from the air, the insecticide being directed to the space occupied by the crop to be protected and its surroundings. Hence, larger quantities of insecticides are used than would be used if the insecticide could be applied directly to, and only to, the target insect.

In addition to the large quanitities of insecticides used, such application techniques are indiscriminate in that all insect species present and the crop itself are contaminated with significant quantities of insecticide. Insecticides so broadcast will affect both useful insects, such as pollinators and also insect predators, which attack the harmful or target insect and can, in many circumstances, be counter-productive.

Since the insecticide will directly contact the crop which is to be protected, if the crop is a food crop, it is normally not safe to apply the insecticide for many days immediately prior to harvesting the crop.

Finally, many insecticides are persistent and applying large quantities of such insecticides to areas of land can create a long-term pollution problem, the consequences of which are not fully understood.

It is known that in many insect species behaviour of the insect is influenced by certain specific volatile substances and mixures of substances. Such chemical substances may, for example, be emitted by the female insect and serve to indicate her location to the male, which travels to the source of the substance. In other cases, volatile substances from appropriate host plants will direct the female to lay her eggs on such plants. In addition, it has been found that certain volatile substances are attractive to particular insect species, although the exact significance of the attraction is not fully understood. In many of these cases the volatile substance is species specific—that is to say, attracts one species of insect. These volatile substances are sometimes known as pheromones, lures or attractants and can attract insects over significant distances. All these substances are hereinafter referred to as insect attractants.

It has now been found that insecticides and insect attractants can be incorporated into compositions from which they can be discharged at a predetermined rate and the present invention provides an insecticidal system which avoids the need to scatter large quantities of insecticide over growing crops and can be used to attract specific insects to an appropriate insecticide, hence reducing the risk of damaging non-harmful insects.

Accordingly, the present invention provides an insect control system comprising an assembly of at least one insecticidal carrier composition and one insect attractant carrier composition, said compositions being formulated to provide effective lives for the compositions of substantially the same period.

In a preferred form of the invention, the effective life of the insecticide is longer than that of the insect attractant so that under no circumstances will the attractant exist in the absence of the insecticide.

The insecticide and insect attractant incorporated into carrier compositions can be mounted in an insect trap or juxtaposed compositions can be prepared: one containing the insecticide and the other the attractant, for example as intertwined strings or tapes.

The carrier composition can conveniently be a polymer plastics material which will release the attractant and insecticide over a period of some weeks, or alternatively, if a fairly fast release rate is required, a celiulosic material, such as compressed paperboard, may be employed. Conveniently, the carrier composition is biodegradable, although if the insecticidal system is to be employed in association with an insect trap or container, then it is frequently convenient to use a polymeric material which can be mounted in an appropriate container or trap. In addition a silica gel adsorbate may be used as the carrier for either or both of the compositions.

Conveniently, the carrier composition comprises a polymeric sheet material incorporating the insecticide and carrying, on at least one surface, a secondary carrier composition

TABLE I

	Attractant (Lure)	Chief Insect Pests Against which Lure is Used
1.	Cue-lure* 4-(p-acetoxy phenyl)butan-2-one	Dacus cucurbitae (Coquillett) (Melon Fruit Fly) Dacus tryoni (Froggatt) (Queensland Fruit Fly) Dacus dorsalis (Hendel) (Oriental Fruit Fly)
2.	Methyl eugenol 4,5 dimethoxy propenyl benzene	Ceratitis capitata (Wiedemann) (Mediterranean Fruit Fly)
3.	Trimedlure Isobutyl ester of 2 methyl (4/5) chloro cyclohexane carboxylic acid	Trichoplusiani (Hubner) (Cabbage Looper)
4.	(Z)-7-dodecen-1-yl acetate	Laspeyresia pomonella (Linnaeus) (Codling Moth)
5.	(E,E)-8-10 dodecadien-1-ol	Adoxophyes orana (Summer Fruit Tortrix Moth)
6.	(Z)-9 tetradecenyl acetate (E)-9 tetradecenyl acetate (Z)-11 tetradecenyl acetate (E)-11 tetradecenyl acetate	
7.	(E)-11-tetradecenal	Choristoneura fumiferana (Clemens) (Spruce Budworm) Choristoneura occidentalis (Freeman) (Western Spruce Budworm)
8.	Z-9-tetradecenyl acetate 20 parts (Z)-9, (E)-12 tetradecadien-1-yl acetate 1 part	Spodoptera exempta (Walk) (Army Worm)
9.	(Z,E)-9,11-tetradecandien-1-yl acetate	Spodoptera littoralis (Boisd) (Egyptian Cotton Leaf Worm)
10.	(Z)-9-tetradecenal (Z)-11-hexadecenal	Heliothis virescens (Fabricius) (Tobacco Budworm)
11.	Capilure*	Ceratitis capitata (Wiedemann) (Mediterranean Fruit Fly)
12.	Z-9-tetradecen-1-ol acetate (Z,E)-9,12-tetradecandien-1-ol acetate	Spodoptera frugiperda (J.E. Smith) (Fall Armyworm Moth) Prodenia eridania (Cramer) (Southern Armyworm Moth)
13.	(Z)-7, hexadecen-1-yl acetate	Pectinophora gossypiella (Saunders) (Pink Bollworm)
14.	(Z)-11 hexadecenal	Heliothis zea (Boddie) (Bollworm, Corn Ear Worm, Tomato Fruit Worm)
15.	(Z)-11-hexadecenyl acetate	Sesamia inferens (Walk) (Purple Stem Borer Moth)
16.	Z-11-hexadecenal-5-parts (Z)-13-octadecenal 1 part	Chilo suppressalis (Walk) (Striped Rice Borer)
17.	Disparlure cis 7, 8 epoxy-2-methyl-octadecane	Porthetria diapar (Lo) (Gypsy Moth)

(*Trade Mark of Food Industries Limited Bromborough, England.)

invention comprising a PVC-based carrier composition. An attractant carrier composition was prepared using:

	Parts by weight
Breon. P 130/1 (PVC Emulsion Polymer –BP Limited)	100.0
DOP (Dioctyl Phthalate–Plasticiser)	54.0
Vimco 249 C (Barium/Cadmium–Stabiliser)	2.5
ED6 (Epoxy Stabiliser–Lankro Chem. Co.)	5.0
Tinuvin P (UV Adsorber–Ciba-Geigy)	0.1
Pigment (Phthalocyanine Green or Chrome Yellow–according to attractant)	0.5
Insect Attractant	3.3

Approximately 15% of the plasticiser was charged into a mixer and the PVC polymer emulsion then added, followed by the remainder of the constituents in the order listed above. The balance of the plasticiser was then added, followed by the remainder of the constituents in the order listed above. The balance of the plasticiser was then added and mechanical mixing commenced, first at low speed and then at a higher speed, until a smooth paste was obtained which was passed through a triple-roll mill. The resultant paste was spread to a desired thickness (approximately 2 mm) onto a release paper and heated to 180 to 200°C for 3 minutes and then cooled for 10 minutes. This carrier composition contained approximately 2% by weight of the insect attractant.

Using a similar technique, an insecticide-containing carrier composition was prepared from the following formulation:

	Parts by weight
Vinmol E10/65F (PVC Emulsion Polymer)	100.0
B.Br. (Butyl Benzyl Phthalate Plasticiser)	60.0
Vinco 249 C (Barium/Cadmium Stabiliser)	2.5
ED6 (Epoxy Stabiliser–Lankro Chem. Co.)	5.0

	Parts by weight
Tinuvin P (UV Adsorber–Ciba-Geigy)	0.1
Pigment (Azo Red)	0.5
Insecticide	42.0

This yielded a carrier composition containing approximately 20% by weight of insecticide.

Example I

A carrier composition comprising, as an insect attractant, methyl eugenol, which is an attractant for the Oriental Fruit Fly, was prepared as described above. The carrier composition contained 2% by weight of the methyl eugenol.

A further carrier composition comprising insecticide was prepared, this time using, as insecticide, a mixture of equal parts by weight of:

Dichlorvos	2,2,dichlorvinyl-dimethyl phosphate
Naled. Dibrom	1,2-dibromo-2-2,dichloro ethyl dimethyl phosphate
Malathion	0,0-dimethyl S-diethyl-mercapto succinate phosphorodithioate

This insecticidal carrier composition contained 20% by weight of composition of the mixture of insecticides.

Constituents	Composition % by weight
Polyvinyl chloride PVC Corvic D65/02	55.33
DIDP Plasticiser (Drisodecylphthalate)	29.57
Mark 33 (Calcium/zinc oxides) Stabilizer	1.38
Mark C Antioxidant (Trinonyl phenyl phosphite)	0.28
Paraplex G62 (Stabiliser/plasticiser) Epoxy Soya Bean Oil	2.77
Calcium Stearate (Lubricant)	0.18
Ultra-violet Adsorber Tinuvin P	0.06
Red Pigment (Vinamon G)	0.28
Insecticide (Mixture of equal parts of Dichlorvos, Dibrom and Malathion)	10.15
	100.00

Example V

Controlled Release—Lure Compositions

An alternative method of obtaining the desired controlled release rates of the lures and the insecticides, is illustrated:

The selected lure (Cue-lure, methyl eugenol or Trimedlure) was cold mixed into a matrix of an adhesive polymer composition based on acrylic polymer blends 50% and iso propyl acetate 50% (exemplified by Adhesive 5050 of Vinyl Products Limited, Carshalton, Surrey England). The intimately mixed adhesive and lure were spread onto 2 metre unit lengths of one of the following polymer films—each as a separate formulation.

Polythene
Polyvinyl chloride
Terephthalate polyester

These adhesive covered polymer films were then covered with a further polymer film of the same composition. These completed plastic sandwiches were approximately of dimensions 200 cm × 5 cm × 0.3 cm.

Adjuncts such as the antioxidants, ultra-violet screen compounds and dyes were included as required. *Lure contents* (Cue-lure, methyl eugenol or Trimedlure) per unit 2 metre length plastic sandwich strip were:

13.2 to 13.8 grammes

Controlled Release—Insecticide Compositions

In this example, a layer of insecticide, adhesive polymer mixture of composition:

	% by weight
Dichlorvos	37.5
Polymer (5050)	62.5

was spread evenly between two plastic strips (Polyester Terephthalate) Polymer/Insecticide layer was 5 cm wide.

Insecticide composition was:

Concentration	Per cubic centimetre	Per square centimetre	Per Centimetre length
Insecticide Dichlorvos	200.0 mg	8.0 mg	40.0 mg

The weight composition of the system is:

	Grammes	Percent
Total weight of a test strip	6.5	100.0
Weight of plastic film	3.0	46.2
Weight of adhesive polymer (5050)	2.2	33.8
Weight of insecticide	1.3	20.0

The properties of the film compositions used as illustrated by their vapour permeability properties for water vapour and oxygen.

	Thickness				Permeability Value	
Composition	ins	mm	Test Temp. °C	Test Relative Humidity %	Water Vapour gms/m²	Oxygen cc/m²
Polythene	0.001	0.025	25	—	1.0	350.0
PVC	—	0.013	25	75	2.0	192 × 106*
PVC	0.02	0.51	—	—	—	—
Terephthalate (Polyester)	0.001	0.025	38	90	0.90	19.0

*Test carried out at 21°C and 44% relative humidity.

In the accompanying drawings:
Graphs 1 and 1A show the release of the active components of Example I.
Graph 2 gives similar information in relation to Example II.

CLAIMS

1. An insect control system comprising an assembly of at least one insecticidal carrier composition and one insect attractant carrier composition, said compositions being formulated to provide effective lives for the compositions of substantially the same period.

2. An insect control system as claimed in Claim 1 in which the effective life of the insecticidal composition is longer than that of the attractant composition.

3. An insect control system as claimed in Claim 1 or 2, in which the assembly of compositions is juxtaposed.

4. An insect control system as claimed in Claim 3 in which the juxtaposed compositions are in the form of interwinded tapes or strings.

5. An insect control system as claimed in Claim 3 in which one carrier composition comprises a polymeric sheet material incorporating the insecticide and carrying, on at least one surface, a secondary carrier composition containing the insect attractant, the secondary composition being in the form of discreet particles.

6. An insect control system as claimed in Claim 5 in which the discreet particles formed from the secondary carrier composition and the insert attractant are in the range of diameters up to half the length of the insect under attack.

7. An insect control system as claimed in Claim 3 in which one of the compositions is in micro-encapsulated form and carried on the surface of the other composition.

8. An insect control system as claimed in any one of the preceding claims in which the assembly is located in an insect trap.

9. An insect control system, substantially as described herein, with reference to the Examples.

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